DISTRIBUTED OBJECT-ORIENTED GEOSPATIAL INFORMATION DISTRIBUTION SYSTEM AND METHOD THEREOF

RELATED APPLICATION

The present application is related to the commonly assigned pending U.S. patent application Ser. No. 09/448,765 filed on Nov. 24, 1999 entitled "Method and Apparatus for Building and Maintaining an Object-Oriented Geospatial Database", which is incorporated by reference herein. This application claims priority from a provisional application, Ser. No. 60/227,847 filed on Aug. 25, 2000, entitled "A DISTRIBUTED OBJECT-ORIENTED GEOSPATIAL INFORMATION DISTRIBUTION SYSTEM AND METHOD THEREOF", Navy Case No. 80, 172.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to distributing information of an object-oriented database using object-oriented technology. More particularly, the present invention relates to distributing and maintaining information of an object-oriented database of geospatial data. Further, the present invention relates to distributing and maintaining information of an object-oriented database of geospatial data of multiple data types, such as Vector Product Format (VPF), Raster Product Format (RPF), Text Product Standard (TPS), Environmental Systems Research Institute, Inc. (ESRI) shape files, Generic Sensor Format (GSF), oceanographic ASCII text data provided by the Naval Oceanographic Office (NAVOCEANO) and geospatial data with temporal information.

2. Description of the Related Art

The object-oriented geospatial database (i.e., database including data having spatial information) described in the pending commonly assigned application referenced herein implements object-oriented geographic data models of vector mapping data, such as VPF. Geographic data modeling using object-oriented technology is in contrast to conventional geographic or geospatial databases, which are implemented as "relational" data models or structures. For example, as discussed in the pending commonly assigned application, in a complex relational database model of vector mapping data, such as VPF provided by the National Imagery and Mapping Agency (NIMA), the database model is represented as "databases", each "database" containing one or more "libraries" with associated "coverages or themes", and "features" associates with each "coverage or theme". In particular, the "relational" data model paradigm typically requires that the "coverage", "features", and topological data reside in many tables that must be queried upon every request for information from the database. Because of the number of tables involved, maintaining referential integrity of the VPF database upon an update is difficult. This difficulty arises because the VPF relies on data residing within multiple specialized tables on multiple levels of the VPF relational database. Further, since viewing, query and manipulation of each geospatial data of a different format typically requires corresponding software, integration of the geospatial-data of different formats becomes difficult at best.

Further, as described in the pending commonly assigned application, in contrast to relational database structures storing geospatial data, an object-oriented data structure storing geospatial data, topological and other spatial relationships reside in linked objects, and updates to the data can be handled more simply and directly. The object-oriented paradigm properties of identity, encapsulation, inheritance, and polymorphism, overcome the problems associated with existing mechanisms for querying, updating, and translating geospatial data, such as VPF data, by providing a geospatial information distribution system that permits easy and complete updating of VPF data, more complex queries of VPF data, and direct exporting of VPF data from the object-oriented database structure into a relational database structure. In particular, the object-oriented paradigm accommodates data-driven (i.e., data structure of data does not have to be known prior to query for information) queries, constrained query, and nested or complex queries. Further, the object-oriented paradigm also permits easy use of data of differing formats and structures within an integrated geospatial information system. In particular, existing data in VPF, RPF, and TPS files are incorporated onto a single, object-oriented platform for access.

A characteristic of a traditional geographical information system (GIS) based upon the "relational" database structure, is that a user's interaction with data via a user interface is at visual level. For example, the interaction between a user and a map display is only at visual level when zooming. In particular, queries in such traditional GIS are considered "pre-formatted" requests. This characteristic frustrates easy distribution and access to continuously updated complex data having spatial information and temporal information.

Further, generally, users have to utilize many software applications on their local computer to access and display mapping data of multiple data types. Typically, data distribution in such systems is in the form of CD-ROM or other media, and would often take days to be distributed to user. For example, data associated with an area of interest (AOI) would be located in several different places (i.e., there is not a single source that users could access to obtain all mapping data available for the AOI). Although, efforts have been made to provide retrieval and viewing of mapping data over the World Wide Web (WWW) these applications are limited in the data types that they can display, and in the availability of data associated with the display. In particular, regarding accessing geospatial databases, traditional systems that use removable storage media replace the existing database on the removable storage media with updated database and distribute the updated database to users. Further, a separate software application or commercial off the shelf software package, such as a GIS software package (e.g., ArcView by Environmental Systems Research Institute, Inc., Redlands, Calif.) customized for or compatible with the database is executed on the user's or local computer (i.e., client computer) to access the database. Such traditional systems may also be implemented over the Internet or the WWW. Similar to the counterpart non-Internet implementations, the database is stored as a library on a server computer connected to the Internet and the library is distributed (i.e., downloaded by the user or local computer using, for example, File Transfer Protocol) to the user's or local computer for access using the separate GIS software package executing on the local computer. Therefore, these traditional systems involve two steps of loading or downloading data or database to the local computer from the remote computer or removable storage media (e.g., CD-ROM) and then loading a separate software application in the local computer to access the data.

The use of geographic data is becoming pervasive across many disciplines. At the same time, end users are becoming increasingly dependent upon the web as a source of readily available, easily accessible information. Accordingly, in view of these two factors there is a need for development of